AMENDMENTS TO THE SPECIFICATION

Please replace the first second full paragraph on page 2 (lines 8-13) with the following amended paragraph:

It is an object of the present invention to provide a radio reception apparatus ~~using~~, in which a vector difference method ~~capable of~~ handling frequency ~~shifts~~ offsets is used, capable of drastically improving the sensitivity and stably establishing synchronization even in a communication environment with feeble reception signals.

Please replace the second full paragraph on page 2 (lines 14-21) with the following amended paragraph:

This object can be attained by performing vector addition processing before calculating difference vectors. Through this addition processing before calculating difference vectors, the signal component and error component are subjected to a vector addition and power addition, respectively, providing an advantageous feature that the signal-to-noise ratio (~~CNR~~ SNR) is relatively improved.

Please replace the last paragraph beginning on page 10 (p.10, lines 21- p.11, line 11) with the following amended paragraph:

The present invention carries out matched filtering processing through convolver 104 before calculating difference vectors. In matched filtering processing, desired signal components are subjected to a vector addition, while noise components are subjected to a power addition. The result of this vector addition corresponds to the result of a power addition, and therefore power of a desired

signal is affected by the result of the vector addition at a rate of the square thereof. Thus, calculating the power ratio of the desired signal component to the noise component allows a large gain to be obtained. This makes it possible to detect a desired signal with a maximum ~~C/N~~ S/N ratio (gain) from a reception signal with superimposed noise. Calculating difference vectors (delay detection) after this means calculating difference vectors using a reception signal without superimposed noise, and can reduce the error rate of the signal after delay detection as a result.

Please replace the first full paragraph on page 11 (lines 12-21) with the following amended paragraph:

The contents described above will be explained using FIG.2A to FIG.2D. FIG.2A shows an I (in-phase component) signal of a reception signal and FIG.2B shows a Q (quadrature component) signal of the reception signal. In order to eliminate a frequency offset as in the case of the prior art, applying a difference vector calculation to the I signal shown in FIG.2A and Q signal shown in FIG.2B would mean a calculation between signals with superimposed noise and deteriorate the ~~C/N~~ S/N ratio as shown in FIG.2C.

Please replace the last paragraph beginning on page 11 (p.11, line 22 - p.12, line 2) with the following amended paragraph:

The present invention applies matched filtering processing using a known signal to the I signal shown in FIG.2A and Q signal shown in FIG.2B first. This increases the gain of the desired signal to noise and improves the ~~C/N~~ S/N ratio of the reception signal. Applying a difference vector

calculation to this signal with the improved ~~C/N~~ S/N ratio to eliminate the frequency offset will improve the accuracy of detecting a synchronization estimation signal as shown in FIG.2D.

Please replace the last paragraph beginning on page 12 (p.12, line 8 - p.13, line 3) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation length determination section 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. The greater the calculation series length, the greater the effect of averaging noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc. For this reason, whether or not to increase calculation series length s up to a size equivalent to the known signal series length should be considered according to the situation as appropriate. The optimal value of this calculation series length s depends on conditions such as the symbol rate, frequency accuracy and system design. In general, the frequency accuracy is sufficiently high with respect to the symbol rate, and therefore problems are not likely to occur if s is set within the range of 4 to 6.

Please replace the second full paragraph on page 18 (lines 6-20) with the following amended

paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. The greater the calculation series length, greater the effect of averaging of noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc.

Please replace the last paragraph beginning on page 23 (p.23, line 26 – p.24, line 12) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. The greater the calculation series length, greater the effect of averaging of noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc.

Please replace the last paragraph beginning on page 24 (p.24, line 23 – p.25, line 3) with the following amended paragraph:

This embodiment describes the case where difference calculation section 105 calculates difference vectors corresponding to 1 symbol, but calculating difference vectors between 2 symbols doubles the amount of variation of difference vector 114 corresponding to the frequency. Because of this, when the ~~CNR~~ SNR is sufficient and it is desired to improve the frequency accuracy, it is recommended to increase calculation symbol intervals.

Please replace the last paragraph beginning on page 30 (p.30, line 26 – p.31, line 12) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. The greater the calculation series length, greater the effect of averaging of noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc.

Please replace the last paragraph beginning on page 31 (p.31, line 23 - p.32, line 3) with the following amended paragraph:

This embodiment describes the case where difference calculation section 105 calculates difference vectors corresponding to 1 symbol, but calculating difference vectors between 2 symbols doubles the amount of variation of difference vector 114 corresponding to the frequency. Because of this, when the ~~CNR~~ SNR is sufficient and it is desired to improve the frequency accuracy, it is recommended to increase calculation symbol intervals.

Please replace the last paragraph beginning on page 36 (p.36, lines 19 –p.37, line 5) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. The greater the calculation series length, greater the effect of averaging of noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc.

Please replace the second full paragraph on page 43 (lines 6–20) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where

calculation series length s is not 4. The greater the calculation series length, greater the effect of averaging of noise is. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment. On the other hand, since the phase is shifted for every symbol due to influences of frequency shifts, increasing calculation series length s will make the system more susceptible to frequency shifts, etc.

Please replace the frist full paragraph on page 46 (lines 3-13) with the following amended paragraph:

Reception situation estimation section 501 estimates its ~~CNR~~ SNR using demodulated signal 110 and outputs the estimation result to calculation length control section 503 as estimated reception situation 502. Calculation length control section 503 controls the calculation series length according to estimated reception situation 502. For example, calculation length control section 503 controls calculation series length 119 (s) to a large value if the ~~CNR~~ SNR is good and controls calculation series length 119 (s) to a small value if the ~~CNR~~ SNR is bad.

Please replace the second full paragraph on page 497 (lines 11-24) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. Calculation series length s is a value controlled by calculation

length control section 503 and is variable as described above. Regarding control of calculation series length s, the case where ~~CNR~~ SNR of demodulated signal 110 is estimated is shown as an example, but it is also possible to use parameters other than ~~CNR~~ SNR, for example, reception power, reception quality (quality factor such as Eb/No). The greater the calculation series length s, the greater the effect of averaging noise is.

Please replace the last paragraph beginning on page 52 (p.52, line 22 - p.53, line 4) with the following amended paragraph:

Reception situation estimation section 501 estimates its ~~CNR~~ SNR using demodulated signal 110 and outputs the estimation result to calculation length control section 503 as estimated reception situation 502. Calculation length control section 503 controls the calculation series length according to estimated reception situation 502. For example, calculation length control section 503 controls calculation series length 119 (s) to a large value if the ~~CNR~~ SNR is good and controls calculation series length 119 (s) to a small value if the ~~CNR~~ SNR is bad.

Please replace the second full paragraph on page 56 (lines 12-25) with the following amended paragraph:

This embodiment describes the case where calculation series length 119 (s) given by calculation series length 118 is 4, but the present invention is also applicable to a case where calculation series length s is not 4. Calculation series length s is a value controlled by calculation length control section 503 and is variable as described before. Regarding control of calculation

series length s, the case where ~~CNR~~ SNR of demodulated signal 110 is estimated is shown as an example, but it is also possible to use parameters other than ~~CNR~~ SNR, for example, reception power, reception quality (quality factor such as Eb/No). The greater the calculation series length s, the greater the effect of averaging noise is.

Please replace the last paragraph beginning on page 56 (p.56, line 26 - p.57, line 6) with the following amended paragraph:

For this reason, if estimated reception situation 502 of reception situation estimation section 501 is good, reducing the value of calculation series length s can also simplify the calculation. For example, an improvement to the characteristic by averaging is expected by setting s=4, thus drastically alleviating the reception environment condition for establishing synchronization and offering prospects of great effects especially in a harsh ~~CNR~~ SNR environment.

Please replace the frist full paragraph on page 63 (p.60, lines 10-20) with the following amended paragraph:

For this reason, if estimated frequency 302 of frequency estimation section 301 is good (the error from the target value is small or when estimated frequency 302 shows a frequency shift, its absolute value is small), reducing the value of calculation series length s can also simplify the calculation. When frequency estimation section 301 does not output estimated frequency 302 as in the case of the first execution, it is desirable to give an optimal initial value to the system obtained from the frequency error range, symbol rate and sensitivity point ~~CNR~~ SNR, etc.

Please replace the last paragraph beginning on page 63 (p.63, line 21 - p.64, line 1) with the following amended paragraph:

This embodiment describes the case where difference calculation section 105 calculates difference vectors corresponding to 1 symbol, but calculating difference vectors between 2 symbols doubles the amount of variation of difference vector 114 corresponding to the frequency. Because of this, when the ~~CNR~~ SNR is sufficient and it is desired to improve the frequency accuracy, it is recommended to increase calculation symbol intervals.

Please replace the last first full paragraph on page 70 (lines 13-23) with the following amended paragraph:

For this reason, if estimated frequency 302 of frequency estimation section 301 is good (the error from the target value is small or when estimated frequency 302 shows a frequency shift, its absolute value is small), reducing the value of calculation series length s can also simplify the calculation. When frequency estimation section 301 does not output estimated frequency 302 as in the case of the first execution, it is desirable to give an optimal initial value to the system obtained from the frequency error range, symbol rate and sensitivity point ~~CNR~~ SNR, etc.

Please replace the last paragraph beginning on page 70 (p.70, line 24 – p.71, line 4) with the following amended paragraph:

This embodiment describes the case where difference calculation section 105 calculates difference vectors corresponding to 1 symbol, but calculating difference vectors between 2 symbols

doubles the amount of variation of difference vector 114 corresponding to the frequency. Because of this, when the ~~CNR~~ SNR is sufficient and it is desired to improve the frequency accuracy, it is recommended to increase calculation symbol intervals.

Please replace the last paragraph beginning on page 72 (p.72, line 24 – p.73, line 1) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the reception time of the known signal series with stable performance from the reception signal series received in a harsh environment of signal to noise ratio (~~CNR~~ SNR).

Please replace the last paragraph beginning on page 73 (p.73, line 27 – p.74, line 4) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the known signal series sent from a plurality of known signal series candidates and the reception time with stable performance from the reception signal series received in a harsh ~~CNR~~ SNR environment.

Please replace the first full paragraph on page 75 (lines 2–7) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the reception time of the known signal series from the reception signal series

received while changing optimal calculation series length s from the estimated ~~CNR~~ SNR and adapting to the ~~CNR~~ SNR environment adequately.

Please replace the first full paragraph on page 76 (lines 7-13) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the known signal series sent from a plurality of known signal series candidates and the reception time from the reception signal series received while changing optimal calculation series length from the estimated ~~CNR~~ SNR and adapting to the ~~CNR~~ SNR environment adequately.

Please replace the first full paragraph on page 77 (lines 11-16) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal, estimate a frequency shift and detect the reception time of the known signal series and frequency with stable performance from the reception signal series received in a harsh ~~CNR~~ SNR environment.

Please replace the first full paragraph on page 78 (lines 14-20) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal, estimate a frequency shift and detect the known signal series sent from among a plurality of

known signal series candidates, the reception time and frequency with stable performance from the reception signal series received in a harsh ~~CNR~~ SNR environment.

Please replace the first full paragraph on page 82 (lines 3-7) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the reception time of the known signal series with stable performance from the reception signal series received in a harsh ~~CNR~~ SNR environment.

Please replace the first full paragraph on page 83 (lines 6-11) with the following amended paragraph:

This configuration makes it possible to detect a target known signal series from the reception signal and detect the known signal series sent from a plurality of known signal series candidates and the reception time with stable performance from the reception signal series received in a harsh ~~CNR~~ SNR environment.

Please replace the second full paragraph on page 83 (lines 12-20) with the following amended paragraph:

As shown above, the present invention can achieve great effects in synchronization processing especially in a harsh reception ~~CNR~~ SNR environment. Furthermore, the present invention performs processing basically through calculations of difference vectors, which is little

affected by frequency shifts in the reception environment, and is therefore extremely effective especially in the case of synchronizing with the system for the first time after power is turned on.

Please replace the third full paragraph on page 83 (lines 21-24) with the following amended paragraph:

Moreover, since the ~~CNR~~ SNR of a correlation value is relatively high, and therefore estimating a multipath environment using this provides prospects of high estimation results.